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ABSTRACT

This paper explores four students' attempts at teaching science in the real world classroom during their initial student teaching practicum including their struggles and successes. When pre-service teachers enter their initial practicum experience they are confronted with differing teaching philosophies of their own, university professors, and school mentors (Sullivan, Mousley, Gervasioni, 2000; John, 2001; Fu and Shelton, 2002). Within this situation, preservice teachers struggle to find their own niche of teaching science and learn to reflect as both a learner and teacher (Kelly, 2000). Our goal as science teacher educators is to help pre-service teachers have an easy transfer from personal university experiences to teaching science in the "real" classroom school environment while maintaining the integrity of newly learned teaching strategies (Segall, 2001). This work adds to and helps guide science teacher educators in identifying difficulties pre-service teachers experience in the transfer from methods courses to practice. This work is a section of a larger work exploring explicit instruction of the Nature of Science and its subsequent application in the classroom. Specifically, this work investigates the transition from university methods courses to practical experiences in the classroom. In addition, this work offers ideas and suggestions for enhanced relationships between university methods instructors, supervisors, and school mentors while aiding preservice teachers in adjusting to their own classroom experiences with teaching science. (Contains 27 references.) (Author)

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Abstract

This paper explores four students' attempts at teaching science in the real world classroom during their initial student teaching practicum including their struggles and successes. When pre-service teachers enter their initial practicum experience they are confronted with differing teaching philosophies of their own, university professors, and school mentors (Sullivan, Mousley, Gervasioni, 2000; John, 2001; Fu and Shelton, 2002). Within this situation, preservice teachers struggle to find their own niche of teaching science and learn to reflect as both a learner and teacher (Kelly, 2000). Our goal as science teacher educators is to help pre-service teachers have an easy transfer from personal university experiences to teaching science in the "real" classroom school environment while maintaining the integrity of newly learned teaching strategies (Segall, 2001). This work adds to and helps guide science teacher educators in identifying difficulties pre-service teachers experience in the transfer from methods courses to practice. This work is a section of a larger work exploring explicit instruction of the Nature of Science and its subsequent application in the classroom. Specifically, this work investigates the transition from university methods courses to practical experiences in the classroom.In addition, this work offers ideas and suggestions for enhanced relationships between university methods instructors, supervisors, and school mentors while aiding preservice teachers in adjusting to their own classroom experiences with teaching science.

Science in the trenches: An exploration of four pre-service teachers' first attempts at teaching science in the classroom.

Traditional models of student teaching practicum form a natural bridge for education students to make the change from student to teacher. This time honorerd practice, similar in apprenticeship programmes in many ways, provides students opportunities to experience what they themselves learned in classrooms regarding teaching. What makes this practice so viable? What is it that makes it succesful enough that we continue to count on it for entry into the education profession? These questions may lead investigators to believe that student teaching practices are an enigma (John, 2001); however, for those of us who teach educational methodology courses, we believe this practicum, or time in the schools, is succesful due to the exhaustive pre-preparation stages we attempt to transfer to our students in our methods courses (Kelly, 2000). Unfortunately, just learning the methodology behind teaching a subject does not necessarily guarantee transfer of successful teaching of that subject in the classroom. This work is a sub-section of a larger work exploring explicit instruction of the Nature of Science in university courses and its subsequent application in the elementary and secondary classroom. Specifically, this work investigates the transition from university methods courses to practical experiences in the classroom by exploring four students' attempts at teaching science in the real world classroom during their initial student teaching practicum including their struggles and successes.

Statement of Problem

Education reform movements since the early 1990s seek to implement inquiry-based constructivist practices focusing on scientific literacy thereby instilling a basic understanding of

the nature of science into the science classroom (Black, 1994). According to Bright and Yore (2002), educators have yet to overcome the barriers interfering with effective science classroom instruction intended to increase student scientific literacy. A major component of this interference lies within teachers' lack of experience in constructivist teaching and learning. Often constructivist techniques place teachers in roles that are uncomfortable or unfamiliar. This discomfort, coupled with increasing demands on teachers' time for duties unrelated to teaching, presents a need for greater understanding and familiarity with constructivist guided inquiry practice within the preservice experience (Beck *et al.*, 2000). Through providing prior experience exploring an inquiry-based classroom, appropriate planning strategies related to curriculum, and establishing trusting relationships between mentor teachers and science experts, preservice teachers can experience a more interconnected and valuable experience in the classroom (Crawford, 1999).

During the last several years, the elementary education programme at the University of Victoria has undergone significant changes in structure and delivery. Science methods courses were reduced from two units to 1.5 units of course credit. Within this structural change also occurred a difference in delivery. Originally, elementary science education students would attend classes for 8 weeks, followed by an initial 6-week practicum in the schools. After the winter holiday, students would resume class instruction for another 10 weeks before their concluding 6-week practicum (Bright & Yore, 2002). Currently, students attend science methods class sessions for 12 weeks after which they participate in a five-week practicum session in an elementary school. The reduction of class sessions from 16 weeks to 12 weeks is considerable along with the reduction of the school experience from 12 weeks to 5 weeks.

Presently, these courses teach the nature of science implicitly as included or modeled as part of instruction.

Teaching that is consistent with the nature of scientific inquiry involves effectively practicing science process skills in order to keep pace with the rapidly changing knowledge base in science (Black, 2002). The BC Science IRP curriculum supports increasing student understanding of the nature of science by stating:

> "The science curriculum of British Columbia provides a foundation for the scientific literacy of citizens, for the development of a highly skilled and adaptable work force, and the development of new technologies. It is a foundation on which teachers can develop a science program that provides a comprehensive set of knowledge, skills, and experiences related to science... Classroom practice and teaching strategies should promote positive attitudes toward science... In this curriculum, students develop the knowledge, skills, and attitudes necessary for scientific literacy through four major processes: working scientifically, communicating scientifically, using science, and acting responsibly (BC IRP pg. 2)."

The present course seeks to maximize, within a limited programme structure, instructional techniques based on science process skills, student familiarity with the BC Science K-7 Curriculum, increase student scientific literacy, and improve student understanding of the nature of science as it relates to the classroom experience. However, currently there is no structure in place to provide instructors feedback as to the success of this knowledge transfer from science methods courses into actual classroom practice.

Within the 'old programme', methods instructors had some measure of feedback regarding the student teaching practicum when students returned after their first 6-week practicum. During the next ten weeks of classroom instruction, instructors addressed issues that arose in the schools related to science curriculum and instruction. Although after the final practicum experience, there existed no measure of success to the methods' instructors unless they personally contacted student supervisors. With an average of 60-90 students in two to three methods courses, this was not a viable option for obtaining feedback; hence, a scattered and incomplete picture of the success of the students' success emerged. At least in the 'old programme' instructors had some way of acknowledging a certain amount of knowledge transfer from the students' initial experiences; however, in the new, reduced time limit course structure there is no means to establish success or failure of students' experiences in the classroom with relation to their teaching science.

Purpose of Study

Inherently, the purpose of this study is to examine the perceived success of student teachers in their first initial practicum during their fourth year of study. This study attempts to identify patterns related to appropriate transfer of knowledge gained from science methods courses into actual practice in the field. Additionally, it serves to provide an initial description for methods instructors regarding transfer of effective teaching and learning strategies for the science classroom along with a basic picture of student understanding of the nature of science and its applications to the elementary science classroom.

EDUC 403 Elementary Science Methods presents a three-fold approach to teaching science literacy to preservice teachers including emphasis on: the Nature of Science, science process skills; British Columbian K-7 Science Curriculum; and, teaching strategies including

four-part guided inquiry, learning cycle, and alternative teaching strategies of jigsaw learning, reading/writing in science, field experiences, and computer technologies. To be more specific, the course follows the four areas associated with constructivist teaching and learning including hands-on activities, discussion, group work, and problem-solving assessment (Saunders, 1992; Kelly, 2000). Through the cohesive nature of course design within this study, there is an increased potential for collaborative learning between students and instructor. Not only does the potential exist for greater skill development, critical learning, and life long learning through this course design, it has the capability to increase scientific literacy among participants.

In a broader sense past university classroom experiences, this study serves to examine whether transfer of these foci take place in the student teachers' initial practicum experience in the school system, what perceptions students' emerge from their practicum regarding teaching science, and to identify students' views regarding planning, barriers to implementation, assessment, material availability, support from mentors and supervisors, teachable moments and elementary students' attributes, and finally, their attitude toward the experience as a whole. In essence, this study seeks to improve the communication process between student teachers, mentors, and university supervisors (John 2001).

Theoretical Background

Our goal as science teacher educators is to help pre-service teachers have an easy transfer from personal university experiences to teaching science in the "real" classroom school environment while maintaining the integrity of newly learned teaching strategies (Segall, 2001). In addition, practice teaching provides opportunities for students to make judgements about their own effectiveness in a classroom based on their content knowledge and application of pedagogical skills (Kelly, 2000). When pre-service teachers enter their initial practicum

experience they are confronted with differing teaching philosophies of their own, university professors, and school mentors (Sullivan, Mousley, & Gervasioni, 2000; John, 2001; Fu & Shelton, 2002). Within this situation, preservice teachers struggle to find their own niche of teaching science and learn to reflect as both a learner and teacher (Kelly, 2000).

University method's goals and transfer to practice

While establishing individual teaching styles is an integral part of becoming a teacher, university education programmes, and methods courses in particular, emphasize a direct connection between learning that takes place in the university classroom and subsequent teaching in the elementary classroom. At this stage of the education student's experience, connection between pedagogy, content, and practice meld together (Kelly, 2000). Too often in science, many of the pedagogical strategies emphasized in the science methods classroom are lost when students reach the elementary classroom due to the barriers facing them, such as differing teaching styles between mentors and students, time factors, particular classroom situations, and lack of support from mentors or supervisors (John 2001). A cohesive concreting between pedagogy and conceptual knowledge provides greater confidence on the part of the student teacher when they begin their student teaching (Plourde, 2002). Kelly (2000) believes that as we strengthen the bonds within the methods courses to focus on construction of knowledge and enhances pedagogical strategies through explicit instruction on the Nature of Science (NOS) and Scientific Literacy, we provide students a stronger platform from which to begin their own individual practice.

Nature of Science

Each person has a need to figure out how nature and the world around us works and operates. We carry an innate sense of wanting to make sense of our surroundings. Science

provides the vehicle through which we can begin to understand the phenomena of nature. Too often science, as practiced or thought, leaves us confused. As science educators, we can help our students and future teachers begin to understand the true nature of science and learn to become literate within the realm of scientific endeavor.

Three definitions of the nature of science guide our existing science education practice. The first, a traditional or absolutist/realistic, view of science suggests that science knowledge offers true descriptions and explanations of the real world most commonly accepted by 'hard' or practicing scientists. The second, a naïve realist, evaluative contemporary view of science advocates temporary descriptions of the real world within our limited sensory and intellectual abilities most commonly accepted in educational practices. A third definition of the post modernist idealist, relativist idea explores the notion that science knowledge embodies multiple explanations and descriptions of reality and it is impossible to measure accuracy within this system (Bright and Yore, 2002). Most curriculum standards documents support the agreement within international reform literature that suggests a measure of consensus among science educators (Lederman, 1999, McComas et al., 1998). McComas (1998) offers an excellent description of the nature of science related to the purpose of this study:

> Scientific knowledge, while durable, has a tentative character. Scientific knowledge relies heavily, but not entirely, on observation, experimental evidence, rational arguments, and skepticism. There is not one way to do science (therefore, there is no universal step-by-step scientific method). Science is an attempt to explain natural phenomena… People from all cultures contribute to science. New knowledge must be reported clearly and openly. Scientists require accurate record keeping, peer review, and

replicability... Science is part of social and cultural traditions. Science and technology impact each other (p. 6).

The nature of science continues as a major goal of science education and within the middle-of-the-road rather than a traditional or postmodernist view of science, science educators find consensus in focusing on science as inquiry, evaluation, and debate (Bright and Yore, 2002; Windschitl, 2003). Ever changing scientific practices call for changing classrooms - ones in which students learn to question the world around them through the use of science process skills. Distilling the nature of science, nature of the learner, needs of society, needs of teacher and classroom is answered effectively through teaching strategies that incorporate inquiry learning, learning cycles, learning styles, content reading, and teaching skills from across the curriculum.

All learners have differing learning styles often referred to in terms of visual, auditory, kinesthetic, or proprioceptive. Each learning situation touches students in differing manners. To effectively teach all students a variety of teaching methodologies is desirable. Some alternative teaching strategies in addition to four-part guided inquiry and learning cycle techniques in a constructivist classroom include: cooperative learning, jigsaw learning, field experiences, science fairs, science inventions, and reading/writing in science (Black, 2002).

Constructivist practices

In addition to emphasizing the Nature of Science in the methods classroom, focusing on constructivist learning practices promotes conceptual understanding that takes the student from learner to teacher and on to become a life long learner (Kelly, 2000). According to Saunders (1992), there are four main foci that enhance the success of constructivist teaching and learning practices: hands-on activity, discussion, group work, and problem-solving forms of assessment. Hands-on activities refer to investigative experiences that lead students to actively pursue

answers to questions regarding phenomena and to formulate new ideas based on their findings. This term refers not only to active investigation, but also to conceptual understanding of the idea in question (Kelly, 2000). As an integral part of Scientific Literacy is the practice of communication of findings and ideas, constructivist learning utilizes the notion of discussion as a viable means of establishment of conceptual understanding through plausible explanations, elaboration on the explanation, and verbal interpretation of data (Orlich *et al,* 1998; Saunders, 1992; Tobin *et al* 1994). Cooperative learning, or group work, helps students realize what real-world teaching strives to achieve within a given school. It also forms the establishment of a community, encourages building communication skills, and instills a spirit of collegiality while providing a strong force for change (Anderson, 1997). Finally, appropriate assessment techniques on the learning and teaching process emphasize learners' abilities to investigate, question, and reflect on their findings, and to lead to re-questioning (Kelly, 2000).

Within incorporating Scientific Inquiry, the Nature of Science, and constructivist learning practices in the science methods courses lies the importance of instilling these same ideas and skills into the student teacher. The overlying goal of the science methods course, therefore, is to ensure easy transfer of these ideas into practice in the elementary classroom (Segall, 2001). Nevertheless, just teaching and modeling these strategies is not enough to ensure transfer. Appropriate support structures firmly established help ensure this transfer takes place.

Support Structures

Mentors & supervisors

Pre-planning for the classroom provides opportunities for student teachers to begin effective communication with their mentor teachers and university supervisors, but the roles of mentors and supervisors are more complex than just overseeing planning practices. Little (1990)

explores empirical evidence regarding mentoring programmes available to guide the mentor teacher in understanding their role in the student teaching process; however both Little (1990) and Giebelhaus & Bowman, (2002) find little information to inform mentors of their roles and duties. While most teachers enthusiastically agree to mentor student teachers, they are often not prepared or equipped to adequately fill the role (Grimmett & Ratzlaff, 1986; Lewis, 1990). Giebelhaus & Bowman (2002) point out that this deficiency could possibly be related to the trend that most current literature on mentoring focuses on the induction year of the beginning teacher and not during the student teaching phase. While Giebelhaus & Bowman (2002) mention many models provided for mentor teachers to effectively guide their student teachers, this literature targets administrators and not classroom teachers. Their suggestion lies within the notion that professional development in the area of teacher mentoring instruct these teachers how to be effective mentors by teaching them observation and feedback techniques to guide student teachers. Sullivan, Mousley, & Gervasoni (2000) also support the notion that not enough preparation or clear definition goes into preparing mentors to receive student teachers. Some universities, however, do offer some amount of written instruction to guide mentors in their roles. This instruction typically takes the form of an introductory booklet explaining the university programme and expectations of student teachers and mentors along with appropriate observation forms (Uvic Elementary Programme, 2001).

University supervisors, on the other hand, receive explicit instruction on supervising students in the field. At the University of Victoria, elementary and secondary university supervisors received verbal and written training on how to conduct student teaching observations. Supervisors receive forms for reporting, programme information, school information, and other important information regarding requirements of observation and

reporting. Perhaps the greatest obstacle for the university supervisor is that they only have glimpses into the student teaching practicum and that observations become contextualized instead of spontaneous (Sullivan *et al*, 2000).

Even given appropriate training for mentors and supervisors on aiding the student teacher become successful, the most important key to successful relationships is the quality of dialog between all parties (Talvitie *et al* 2000). Active communication between university supervisors, school mentors, and student teachers that focus on the tools necessary for an effective practicum lend greater credibility to the student teaching practice (Malinowski, 2002).

Differing Philosophies

When coming to the classroom each teacher develops their own style; however, differences in the variety of intentions and perspectives among styles between mentors, supervisors, and students recognize that not all parties look at the teaching and learning situation in the same manners. This often presents a dilemma for the student in developing their own individual style rather than replicating or reproducing the style of their mentor or supervisor (Sullivan *et al* 2000). Frequently this dilemma leads to major differences in opinion regarding what is happening in the classroom with all parties not willing to concede rightness and concluding that all the others are wrong (John, 2001). Unfortunately due to lack of experience, it is more than not the student teacher in their untrained vulnerable situation that changes their opinion of teaching to gain approval from those directly responsible for analyzing and judging the student's performance in the classroom (Sullivan et al, 2000; Orland-Barak 2002). This situation leads directly to an imitation of style to achieve the urge of acceptance, in reality often leading the student to make excuses for their practice rather than incorporating constructive suggestions (John, 2001). The student teacher is in the middle of a triangle of experience

between the university supervisor and mentor at two corners and the student at the third (John, 2001). Within this three-pronged model, the student holds the unique position of being both learner and teacher which often leads to confusion of role identity and adds another factor blocked the student teacher's ability to form their own particular learning style (Kelly, 2000). However, with increased efforts at improving communication between students and supervisors, they begin to establish trust in one another and all experience a benefit in changing perspectives (Fu & Shelton, 2002), thereby helping the student teacher gain confidence in establishing their own individual style of teaching.

According to Malinowski (2002), key factors for successful student teaching include a melding between university taught teaching pedagogy, science content knowledge, and classroom practice. Solid organization before entering the classroom, confidence of success, balance between content and strategies, and last of all patience provide an equation for success for the student teacher in the classroom. Convergence between university supervisors, classroom mentors, and student teachers is possible through a dialogue of reciprocal reflection (John, 2001).

Method

This work is a descriptive model designed to identify patterns and themes emerging from student teachers' first experiences of teaching science in the classroom. This is a pilot study designed to establish further direction and guidance for enhancing transfer of learned methodology into the elementary classroom. This study took place on Vancouver Island, British Columbia, Canada.

Beginning in the science methods course taught during the year directly preceding their six week practicum, the instructor taught the science methods course designed around increasing scientific literacy with students, instruction of science pedagogy teaching strategies based on the

Nature of Science and constructivist learning. Upon completion of the course, the instructor was assigned four students to supervise during their student teaching practicum.

Subjects observed in this study included four students in their fourth year of study in elementary education. Two were male, and two female. One male and one female had school placements in rural areas of Northern Vancouver Island, while the other two had school placements in urban communities in the same area. All students were in their mid-twenties and had 'life-experience' in other areas besides education. One student had extensive teaching experience in the field of first aid, another in ice-skating, another in electronics and sales, and the fourth in community service related to drug prevention.

The instructor checked all planning prior to students entering the schools, visited each student in their classroom once or twice per week during the six week time frame, counselled with students and mentors regarding the teaching experience, completed reports from each observation, including a mid-term and final observation form. In addition to these reports, the instructor took notes of her perceptions of the students reactions in various learning situations.

Questions posed to students upon completion of their practicum intended to identify patterns with relation to implementation of pedagogical knowledge in the classroom centred on the area of planning, barriers to implementation, assessment of the learning situation, availabilty of resource materials, support from mentor teachers and university supervisor, perceptions of teaching and learning pedagogy within themselves and with their students, and finally attitude toward future science teaching.

The following questions framed this portion of the study:

1. How did your original planning of science match/mismatch with the classroom experience?

2. What difficulties, obstacles, and barriers did you find in teaching your science unit?
3. Did you measure for prior-knowledge and experiences from your students before beginning your unit? If so, in what way?
4. Did your post instruction assessment adequately (or to what degree) measure what you desired to teach your students? Why or why not?
5. Were your sponsor teacher(s) and university supervisor supportive in your endeavors? (Explain the relationships)
6. Were you able to procure (get) materials and resources for your lessons from your school or district? (If not, were did you get your resources? (I.e. did you buy them yourself?)
7. Tell me about the successes and failures of several students. Perhaps a high, middle, low achiever. Were you able to 'predict' this outcome prior to instruction?
8. Did you or your students have an 'a-ha' moments where instruction was particularly meaningful? (Explain or give one or two examples)
9. Did you have any 'a-ha' moments regarding planning, teaching, and assessing science? (Please give an example)
10. What is your general attitude at this time regarding teaching science in an elementary classroom? Are you currently (or will you be) teaching science in your next practicum? Finally, how has your science teaching experienced shaped your ideas for your career in science?

Results

University Supervisor

Jameson is a high classroom achiever who struggled with chaotic situation in school and classroom. Jameson's classroom was a grade 6 in an urban school. His mentor teacher had not

had a student teacher before and the class itself was often chaotic and confusing due to having at least three different classroom teachers: one major for socials, language arts, physical education, another for math and science, and a third for art and music. Students moved from the main classroom to another for math, then to the library for science (where there were no facilities to for active investigations), to the resource room for art projects, and to the gym or outside for physical education. This particular wing of the school that housed grades 4-7 was noisy, disorganized, and disruptive. All the schools in both districts these students taught in were involved in track meet preparations that took the mentor teacher away from the classroom for prolonged periods. The principal for the school, along with other support staff, were encouraged by Jameson's work in the school and his enthusiasm for the teaching profession. Even though Jameson entered the classroom well prepared, much of his planning changed due to the chaotic nature of the classroom.

Jay has the most more teaching experience of all the students I supervised. Although Jay was not a high classroom achiever as some of the others, he was definitely the best teacher in the classroom. Jay's classroom was a grade 5/6 split in a small rural school with a supportive parent and community base. Jay was fortunate to have an excellent mentor with a well-established classroom. Jay's mentor had mentored several times before and fully understood his role as a mentor teacher for a student. While I did not meet the principal of the school, I did have the opportunity to talk with other colleagues that were supportive and encouraged over the excellent example Jay presented in the classroom. Jay also entered the classroom fully planned and prepared; he noticed a small amount of adjustment to his planning due to actual verses theoretical nature of planning. Jay's teacher was also in charge of the track meet for his school but rather than taking time away from mentoring Jay, he included him in the running of the

school wide programme thus provided school experience outside normal classroom duties. Jay's science unit was extremely successful in that his students learned not only the contextual knowledge he intended, but he also integrated science naturally into his math, language arts, and social studies lessons.

Karen student taught grade 3 in her hometown urban school with well-known mentor teacher. Not only did the mentor teacher have extensive experience in mentoring students, she and Karen had a pre-established relationship that added to their successful relationship as mentor and student. The school had a supportive principal and staff. Karen's teacher was also in charge of the track programme for her school. I found the coincidence between mentor teachers interesting. Karen's relationship with her mentor teacher at first led her to imitate the teacher; however, after she became more comfortable in the classroom she developed her own quiet positive style of teaching. Karen achieved her goals of teaching science in the classroom effectively after a few rough starts at traditional science; her students quickly emerged into active learners.

Kristie's mentor was a relatively new teacher that had never had a student teacher nor had she received any instruction other than the printed packet received from the university. She did not allow much guidance for Kristie, but did allow her freedom to explore within the curriculum. Unfortunately, the mentor teacher stepped in several times when Kristie was teaching and seemed to undermine Kristie's authority with the class. Kristie was professional in each circumstance and able to maintain her connections with the students. The school principal was supportive of Kristie and enjoyed having new ideas brought into her school. Kristie had a number of special needs and interesting situations with individual students that required her to make some adjustments with her teaching and initial planning. Kristie, like each of the other

students, integrated her science unit with several other topics. She was successful and science was an integral part of the classroom.

Student Responses to Questions

1. How did your original planning of science match/mismatch with the classroom experience?

    Jameson: When I planned for science lessons, I was constrained by the room available to me. In that, I couldn't do the hands-on experiments that I would have liked to, but generally, the planning matched the lesson taught.

    Jay: The original planning provided a stable foundation for the classroom experience. Although the planning was modified and adapted throughout the unit, the resource base that was developed within the planning allowed for simple modification

    Karen: I found that I needed to be realistic regarding the amount of materials that would be available to me. When planning I tended not to take into account the amount of materials I would need.

    Kristie: - My planning changed quite a bit once I saw what the students knew and were capable of. I changed my unit plan as I taught it, but I did manage to keep my main lessons and ideas, I just had to add a lesson or two to reinforce the knowledge, and ensure they got the basics. I also found that the unit I had planned was short, I thought it would take longer for the students to complete certain assignments - I found it hard to figure out how long things would take.

2. What difficulties, obstacles, and barriers did you find in teaching your science unit?

<u>Jameson</u>: *Classroom; switching classes. This did NOT work for teaching science effectively. It may have, had the teachers switched rooms instead of the students, because many of the students were preoccupied with what was in the other person's desk rather than the science. Teaching Science in a library also doesn't work for me, as there was no opportunity to mess with stuff.*

<u>Jay:</u> *One must ensure that they understand all the content and are willing to confess to students that "they do not know" however they are "going to find out". Also when planning a unit in the university environment the complex influences of classroom dynamics is usually overlooked. A lesson that may meet typical academic requirements may have very little success in the classroom. Every group of students will act differently to a lesson, being able to adapt the content from the lesson prepared in a methods course leads to a success.*

<u>Karen</u>: *There was never enough time to do all of the things that I wanted to.*

<u>Kristie:</u> *the main difficulties were in making my unit as hands-on as possible. I was teaching animal classification, which is interesting, but it is difficult to think of a variety of 'fun' activities that are of an exploration nature. I also found it difficult in the varying levels within the classroom. Some students took two days, where others took a week to do the same amount of work. - The slight chaos of exploration activities is nerve racking at first; I have to learn to be prepared for everything...*

3. Did you measure for prior-knowledge and experiences from your students before beginning your unit? If so, in what way?

Jameson: I gauged prior knowledge of the human eye with the students by observing their regular science teacher conclude her lessons on other organs of the body. The measurement was strictly formative, kept in the form of notes from which to plan lessons afterwards. However, not every teacher will have the luxury to watch another teach, so prior knowledge could be assessed with similar activities before the main experiment.

Jay: During the planning of my unit I knew very little about the content. After some basic research and brainstorming my knowledge about the subject grew. To measure the students for prior knowledge the first lesson emphasized discovering what they knew and what they wanted to find out. A method that was used was a KWL chart on the board, which was also copied into their books.

Karen: I gave my students a small pre-test to determine what they already knew or what their misconceptions :) were. The test consisted of four squares with a heading in each. They were to draw/write what they thought about that idea in the square.

Kristie: - I didn't last year, but I decided to give the students a pre-test this year, as I didn't know what they had already learned. Astronomy seems to be a popular subject to teach, so I needed to see what they had been taught. I have found already it is helping me plan the lessons, and where to focus my attention. Some

of the questions I thought students would not know, most of them did and vise versa.

4. Did your post instruction assessment adequately (or to what degree) measure what you desired to teach your students? Why or why not?

<u>*Jameson*</u>*: My post instruction assessment matched exactly what I desired to teach, as this was the focus of my planning beforehand. I try to teach with the final objective in mind, to guide students towards the achievement of that goal so my lessons will reflect that in the planning.*

<u>*Jay:*</u> *My expectations for the amount of content for instruction over the time period provided far exceeded the amount that I was able to cover. Every lesson was assessed from the beginning, which led to many changes to the lessons to follow.*

<u>*Karen:*</u> *Yes it did. I had them create a musical instrument (sound unit), which demonstrated the qualities of sound we had studied (volume & pitch changes). They also had to write me a little paper, which answered questions regarding how they made their instruments and how it created the sound. They also discussed how the sound was heard by their ears. I found that this performance assessment allowed my students to demonstrate the full extent of their learning.*

<u>*Kristie:*</u> *Yes, my post instruction assessment did assess what I desired to teach, and the students did very well. I gave them a typical pencil and paper exam; with mainly fill in the blank and matching questions. I think that the students were*

successful because they enjoyed the activities they did, but also I played review games with them to help them prepare for the test, and where I helped them with what I was going to put on the test so that they could focus their studying.

5. Were your sponsor teacher(s) supportive in your endeavors? (Explain the relationship some)

<u>Jameson</u>: *My original sponsor teacher was not linked to the teaching of science. My class visited another teacher across the hall for science. My relationship with both teachers was on good common ground, and they treated me as a colleague, yet understood the need for me to teach the class in order to learn. In this way, both teachers were supportive of the teaching of my units, and offered concise, helpful feedback.*

My supervisor/mentor [was my] Science Teacher from that year's schooling. During the planning phase for the practicum, she provided several helpful planning tips, referenced materials we had used in class, and generally supported the planning process the entire way through. Unfortunately, I didn't have an opportunity to teach as much Science as I would have liked (I notice that many teachers now are alternating between either Science or Social Studies) but when I did teach Science, [the supervisor] not only had many positive comments on the lesson, but many constructive feedbacks to give as well. These did not just pertain to Science, but transferred over to the other subjects I was teaching as well. The comments that were made reflected not only the Science Methods that had been

taught in the University but [the supervisor's] own insights on overall teaching readiness.

<u>Jay:</u> My sponsor teacher was extremely supportive. His suggestions supported my planning and many of the concepts and strategies that were brought to his class were ones that he mentioned that might be continued. One aspect that is frequently over looked in the planning stage is classroom management and organization, which if it is successfully managed can increase the potential of reaching the students. In my opinion, this is due to too much emphasis on content and meeting curriculum goals rather than ensuring the children are behaving and learning.

My university supervisor was very supportive in my endeavors. I feel that the role of the supervisor was to work as a university liaison and ensure that the relationship between the sponsor teacher / practicum student relationship was working. The university supervisor obviously did not see the "big" picture" and have a complete understanding about the student's teaching abilities however they were able to have a glimpse at their capabilities and ensure requirements have been made. I feel that many students are intimidated by the university supervisors. This is probably a result of the handful of supervisors that are over demanding and stress fine details and over emphasis the negative over positive. If you want feedback about yourself, you were very supportive and enthusiastic. At times it may of been apparent that the elementary environment wasn't your specialty, however your willingness to listen, learn, and work with the sponsor

and myself benefited both of us. Having someone to talk to for support and to act as a liaison made the experience more comfortable. I also thank you for making the effort to keep in touch and following our paths.

Karen: *She was incredibly supportive. She worked with me to find resources and materials. She also offered constructive feedback and suggestions when I had questions for her. She helped me to work with the students when I needed an extra hand. I had a wonderful sponsor.*

No comment on the university supervisor.

Kristie: *- My sponsor teacher was supportive. She didn't really give me much to go by as far as planning the unit and actually copied my unit to use in future years. She basically just let me do whatever I wanted to some degree as far as my science unit went.*

- My university supervisor was VERY supportive in my endeavors. Before I started practicum, I had all my lessons checked as usual, but had extra help in science as that was (her) focus. I found it hard thinking of interesting stuff to do with animal classification; but with her help and experience, I managed to write an effective unit. I also got a lot of help in writing my lesson plans (four part guided inquiry), which in turn helped my teaching of all subjects not simply science. I felt very comfortable with you (her), which is huge when you are struggling with the stress of a practicum.

She encouraged hands on, where my sponsor didn't seem to mind what kind of activities I did with the students. My supervisor encouraged me to focus on the

hook or engage part of the lessons and helped me think of effective ways to do this. I really enjoyed having [her] as my supervisor, and learned a lot from [her].

6. Were you able to procure (get) materials and resources for your lessons from your school or district? (If not, were did you get your resources? (I.e. did you buy them yourself?)

<u>Jameson:</u> *The resources I required to plan and teach my small unit on the eye were provided to me by the Science teacher. She procured them from the district resource center in Courtenay.*

<u>Jay:</u> *All resources that we used were either from the district, modified from the web or various district resources. Some manipulatives that were used for lessons were purchased by myself. I do believe that you could get away without spending any personal fund if you are able to improvise and be resourceful.*

<u>Karen:</u> *I was able to get most resources from my district. We ordered the sound kit along with a model of the ear from the district. My school had some tuning forks, which we used. I bought some materials myself as well.*

<u>Kristie</u>: - *I didn't really buy much, but I used a LOT of stuff from the Internet. I.e. descriptions of different animals, lesson ideas, etc. The school library was sufficient for the research project the students did; they got most of their info from books in the library and off the Internet.*

7. Tell me about the successes and failures of several students. Perhaps a high, middle, low achiever. Were you able to 'predict' this outcome prior to instruction?

Jameson: *High achiever: "Why is a red book red when we see it? If we turn off the lights, does it turn to black? What if there was only a small amount of light? And what makes red different than blue?" " Does the image flip upside down because of the shape of the lens?" Middle achiever: "Are there different shapes or sizes or colours of cones to see different colours, or how does the eye see different colours?"*

Low achiever: "Cones see colour. Rods see black and white." (Rote memorization from activities in class)

I was unable to predict some of the successes or failures of individual students. Some students that I expected to come up with brilliant responses (normally over-average) were middle achievers, whereas normally under-achievers gave some brilliant responses. This may have been due to my lack of experience in Science with the class, but I believe that each child will learn and express their learning in different ways. Science may be an easier vehicle for some students to express their knowledge through

Jay: *Several students who were low achievers quickly connected with the unit. They were fascinated with the content and made efforts learn. Using a wide range of instructional strategies ensured to reach out to all the students learning styles and draws them into the unit.*

<u>Karen:</u> I structured my lessons, so that every student was able to participate. The low achievers needed help writing down their results. I had them dictate their thoughts to me, which worked quite well. My science lessons all involved hands on activities, which were able to be done by everyone. I showed my students how to do each activity and then moved about the classroom and offered extra support where it was needed. I helped my students to understand the concepts by demonstrating things and asking them directing questions.

<u>Kristie</u>: - The students were all very successful in the final assessment, which really surprised me given the level of the class (and no the test wasn't easy). The students that were on the lower end of the spectrum did very well on the activities such as "what am I" and the activities where the learning was a little more hidden. The higher achievers did an excellent job in the research project and produced wonderful vertebrate/invertebrate posters. There was for sure some lower level work in a couple of the projects, just sloppy in presentation, but they 'got it' as far as what I was trying to teach.

8. Did you or your students have an 'a-ha' moments where instruction was particularly meaningful? (Explain or give one or two examples)

<u>Jameson</u>: During my evaluated science lesson, one student asked the question "Why is the red book red, and if we turn off the lights, what happens to the colour?" This led the student to do some self-directed research into colour, and he ended up having an AhA moment when he discovered some things about colour. I would like to say that I had a part in this, as even though the student did

a lot of self-directed research on the Internet, the questions that I asked and the way I framed them may have caused the student to begin the search.

<u>*Jay:*</u> *Bringing in live insects for experiments led students to have a hands on connection*

<u>*Karen*</u>*: My students realized that sound is caused by vibrations when we placed tuning forks into water and watched it move. They also realized how it vibrates through air to make sounds when we played with pop bottles. I made a connection of the pitch of the sounds to how they are able to move through water in the swimming pool. Relating it to an experience they were familiar with seemed to help them to grasp the concept.*

<u>*Kristie*</u>*: - I can't remember any specific examples...I learned that you can never be too prepared, and to always have a sample of what work is supposed to look like.*

9. Did you have any 'a-ha' moments regarding planning, teaching, and assessing science? (Please give an example)

<u>*Jameson*</u>*: No AhA! moments during planning :(It was more when I was teaching the lesson, when I listened to some of the questions that students were asking, made me think "Why didn't I think of that?" or "Wow..."*

<u>*Jay:*</u> *I can't recall any exact moments however I would say that during teaching looking around the class at the moment of silence before the outcome of a demonstration experiment is about to happened led me to realize (an "ah-ha" moment as you put it) how powerful science can be. This moment confirmed that*

teachers and the strategies that they use have a powerful impact on student learning. Drawing them into a lesson can be preformed in many ways. Science however can lead to many creative and interactive possibilities. The only other moment that comes to mind is was at after the first lesson with the students. I looked over my detailed unit plan and confirmed that when assessing science you must be prepared to be flexible, and practical. Wrote memorization is often stressed however I believe that a critical and educated understanding of a concept or process is more beneficial in the long run. I had intended to stress the many "parts" and did not look at the "whole" picture. I quickly realized to look at the larger picture "What was the main objective/goal" How could I assess and plan this unit to ensure the students understood the content and concepts and how could I ensure that there is a balance of activities? The assessment prepared in methods class were a great help yet it took working through the lessons with the students and modifying them along the way to create a successful unit.

<u>Karen</u>: I found that many of my moments were not planned. I would move through the lesson and realize how I could make it clearer for them and I would just do it. I tried to pick activities which I felt would clearly demonstrate the concepts, but it was my on the spot instruction and questions which made it clear for most of them.

<u>Kristie:</u> - Be prepared for everything...Even if students say they get it when you are explaining, have them draw a picture or explain to you because I have recently learned that they won't admit they are having troubles 'seeing it' - that's my big 'a-ha'. In assessing science I have learned to use variety in questions and

spend time reviewing concepts covered in the unit at the end of the unit, because they pick up information, but don't always make connections.

10. What is your general attitude at this time regarding teaching science in an elementary classroom? Are you currently (or will you be) teaching science in your next practicum? Finally, how has your science teaching experienced shaped your ideas for your career in science?

<u>Jameson:</u> *I am excited to be able to teach an entire science unit this practicum, in Life Sciences for Gr 6 instead of disconnected units. I think that by teaching a unit with a theme, educators can approach it from a standpoint of science, or social studies, or math, or any other subject. Focusing on one theme gives the students a chance to place everything in one context, to analyze a problem or situation from multiple viewpoints and construct a broader knowledge base, becoming "experts" in one particular area before moving on to the next. My experiences mainly in Science Methods course have shaped my teaching of science. I plan to use many hands-on and minds-on experiments to engage students so that they can experience "real, authentic" science first hand, discovering more about how their world works*

<u>Jay:</u> *I will be teaching science again ~ a unit on space I believe to another grade six class. I am looking forward to teaching science through out my career. IT provides an opportunity for myself and students to learn science in a fun and positive way.*

<u>Karen</u>: *I truly enjoy teaching science. I found that my students were so excited to learn through experiments and hands on activities. When my students enjoy themselves, I am happy. This is what I find most rewarding about teaching. I am really hoping to be able to teach science in my next practicum. I'm not sure how complex it will be, but I will definitely try. I have a science background, so I am confident when teaching science. I guess it has allowed me to see how I can make others enjoy science.*

<u>Kristie:</u> *- I feel a little more confident, but am teaching a much more 'hands-on' unit which is scary at first. I am having them do more exploration activities that are more for them to try figure things out before I tell them, which is VERY scary at first. - I am teaching science in this practicum.*

- hmmmm...I don't know...It's amazing what I DON'T know, I feel like I have to do all the experiments (which is obviously a must in teaching - always do what you are going to teach), but I am actually teaching myself a lot of the stuff because I don't remember anything (I think because I learned from a textbook), basically I am trying to re-learn many science concepts.

Discussion

Observations from the university supervisor and student teachers matched closely with regard to classroom barriers, planning, teaching and learning, assessment, and transfer of knowledge from the science methods classroom into the elementary classroom. Each of the students found that their methods course provided a stable foundation for their planning and classroom teaching even though they all noticed a change in their intial planning upon entering the classroom. Each felt physical contraints based on outside activities taking place in the

school, whether it was track practice, or moving of classrooms, or changing of students during the semester. Some felt that the university courses did not adequately prepare them for the actual dynamic of the classroom and student behaviours which concurs with Kelly's (2000)and Segall's (2001) assumptions that many strategies are lost when pedagogy and content don't connect.

In spite of the reality of the classroom versus the theoretics of the methods classroom, each student effectively integrated science instruction into their classroom by applying constuctivist strategies of hands-on activities, discussion, group work, and assessment (Kelly, 2000; Anderson, 1997; Saunders, 1992). Perhaps the best identifier for success for the students was their pre and post assessment techniques employed to measure learning (Black, 2002). Each felt they accomplished their goals and that students learned what was intended. Additionally, students reported high success with scientific inquiry in their classrooms, although one struggled with the physical make up of the classroom and lack of available time, he was still able to see appropriate transfer of scientific ideas. Each student reported they will teach science in their next practicum and came away with a belief that science is an important and integral part of their individual teaching styles (Windschitl, 2003; Bright & Yore, 2002).

Two of the four students experienced minor difficulties with their mentor teachers which is easily attributed to the mentor teachers' lack of experience or training in guiding student teachers (Giebelhaus & Bowman, 2002; Sullivan *et al* 2000; Little, 1990; Grimmett & Ratzlaff, 1986). However each student felt their mentor teacher's were supportive in their efforts. Four out of four felt they had good support and three out of four felt they received good feedback from their mentors. Three students answered the question regarding the university supervisor, all three felt the supervisor was supportive in their efforts, although one pointed out that the supervisor does not see the 'big picture' of the classroom or the student's abilities to teach. This

is due to the fact that the supervisor receives only glimpses into the classroom during the course of instruction and not a continual observance (Sullivan *et al*, 2000). However, each student did note that they were well prepared and able to teach science in their classroom as they were taught in their methods course (Black, 2002). Communication between student, mentor, and supervisor provided a key component to the students' perceived success in their practicum (Malinowski, 2002; John, 2001).

Conclusion

This work adds to and helps guide science teacher educators in identifying difficulties pre-service teachers experience in the transfer from methods courses to practice. In addition, this work particularly suggests an enhanced relationship between university methods instructors, supervisors, and school mentors while aiding preservice teachers in adjusting to their own classroom experiences with teaching science. Although the questions investigated within this study were arbitrary, designed merely to induce perceptions on bigger topics, this study identifies a need to establish distinctive questions to more effectively measure student teaching successful transfer of knowledge gained in science methods into classroom practice. In addition, it recognizes the need for cohesive training for classroom mentors prior to receiving student teachers and explore new ways of increasing the role of the university supervisor on more than a peripheral member of the team. This work provides positive feedback that there are areas that are working well within our student teaching model of practice and signal that we are definitely moving in the appropriate direction (Sullivan *et al*, 2000) in our efforts of training teachers to teach effective science in the elementary classroom.

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